

Determinants of Student Retention of Microeconomics Principles Concepts

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College professors often express concern about the academic preparation of students in their classes. Economists frequently lament the weak mathematical, logical, and verbal skills of their students. In such cases, blame can conveniently be placed on the poor quality of instruction received in our nation's elementary and secondary schools. A bit more troubling, however, is the frequent observation that students in upper-level classes do not seem to recall many of the fundamental concepts that were taught in introductory economics courses.

Numerous studies have investigated alternative factors that appear to influence student success in mastering basic economic concepts in introductory economics classes. Most of these studies have examined those factors that appear to be related to a high level of student performance at the end of the introductory class, as measured by student performance on a final exam or on a standardized test instrument (typically the TUCE exam).¹

These studies, however, only provide information about the determinants of student's short-term recall of economic concepts at the end of their introductory courses. One of the major purposes of introductory economics classes, however, is to provide students with a basic understanding of the economic theories and concepts that serve as foundation material for more advanced coursework in economics and related disciplines. To determine whether the principles courses are effective in this role, it is necessary to examine the extent to which students recall these fundamental concepts when they begin more advanced coursework. It would also be useful to examine whether alternative modes of delivery of the principles course affects this longer-term recall of fundamental economic concepts. In this study, we attempt to address these issues.

In their extensive study of teaching methods and assessment techniques used in

¹Studies relying on the TUCE exam as a measure of educational outcome frequently use the difference between student TUCE scores at the beginning and the end of the class as a measure of the "value-added" by the course.

introductory economics courses, Siegfried, Saunders, Stinar, and Zhang (1996), observe that economic instruction in introductory classes tends to primarily rely on a traditional lecture approach. Their study indicates that approximately 90% of assessment in such courses is derived from scores on exams and quizzes.² They note that "[t]he vast majority of questions on these tests are multiple choice."³

While "active learning" methods and "writing across the curriculum" programs are increasingly popular in higher education, introductory economics courses tend to be taught primarily using traditional passive learning lecture methods and require very little student writing. Since many economics departments rely on the use of large-section instruction,⁴ active learning methods and extensive writing requirements are often impractical. In this study, we investigate whether large-section instruction and the absence of extensive writing requirements is likely to have a deleterious effect on student learning.

I. The Model

We assume that an individual's stock of knowledge about fundamental microeconomic concepts at a given time is determined by past investments in coursework in the discipline, the individual's efficiency in acquiring new knowledge, and the depreciation that occurs in this stock of economic knowledge over time. The amount by which an introductory class enhances this stock of knowledge is determined by instructor, course, and student characteristics. Students

²Siegfried, Saunders, Stinar, and Zhang (1996, p. 183)

³*ibid.*

⁴As noted by Siegfried, Saunders, Stinar, and Zhang (1996, p. 186), instructional methods in introductory economics courses appear to vary very little with class size.

are expected to learn more when:

- they have more effective and knowledgeable instructors,
- there is a better match between pedagogical techniques and student learning styles,⁵ and
- students have a higher initial stock of human capital, more effective study skills, or exert a higher level of effort in acquiring knowledge.

In the analysis that follows, we examine whether the use of large-section instruction or writing requirements (essay exams or papers) in microeconomics principles classes affects the amount of knowledge retained by students when they begin upper-level coursework in economics.

Class Size

As noted by Siegfried and Kennedy (1997), the effect of class size on student learning is difficult to determine. Large classes may enhance student learning if departments assign their best instructors to these course or if instructors have an incentive to devote more time and resources to preparing for large lecture sections (since the instruction of these courses typically provides the instructor with a reduced teaching load). Student learning would be adversely affected by large class size, however, if the instructors in large classes assign fewer assignments that enhance student learning,⁶ or if student attendance or attention declines in response to a

⁵This topic is addressed in Borg and Shapiro (1996).

⁶A recent study by Miller and Westmoreland (1998), however, suggests that instructors may rely on selective grading procedures without a reduction in student effort. Under this procedure, frequent assignments may be given, but only randomly selected problems are graded. Since their study suggests that such a grading procedure does not adversely affect the level of student effort, instructors of large sections may be able to assign large amounts of work, but only grade a portion of the work without adversely affecting student effort. (Risk-averse students are expected to devote more effort to their work on each problem under such an evaluation system.)

large class environment.⁷ Large classes also may hinder learning by reducing the amount of instructor-student interaction.⁸

Most empirical studies of the effect of class size on student performance in introductory economics classes, however, have found that class size does not have an adverse effect on student learning as measured by exam scores administered at the end of the course. In one of the few economic studies examining the longer-term impact on student learning, Raimondo, Esposito, and Gershenberg (1990) have found that the use of a large-lecture format in the microeconomics principles class has no significant effect on the level of student performance in intermediate microeconomics. They also find, however, that large-section instruction in the macroeconomics principles course has a significant negative effect on performance in the intermediate macroeconomics course. Raimondo *et. al.* argue that large lecture classes are less suited for developing the higher-order cognitive skills needed to understand and answer essay questions involving policy debates in intermediate macroeconomics classes. They suggest that large lecture sections in introductory economics did not adversely affect student performance in the intermediate microeconomics class because policy debates and essay exams are less

⁷The study by Sheet, Topping, and Hoftyzer (1995) suggests that while attendance rates have a significant effect on performance on final exams, attendance rates in microeconomics classes do not appear to vary with class size.

⁸Correa (1993) provides a theoretical model of teacher behavior that predicts that increases in class size will adversely impact student performance as a result of a reduction in the optimal amount of time spent on each student as class size rises. This model does not, however, examine the incentives that face students in such classes, nor does it include the possibility that instructors in large sections face incentives that encourage them to devote more time and resources to class preparation (this assumption may be justified in the elementary and secondary school setting that Correa is primarily addressing, but is less reasonable at the college or university level at which large-section instruction generally provides release-time incentives).

commonly used to assess higher-order cognitive skills in this class.⁹

There is an extensive and inconclusive literature on the effect of class size on academic performance at the elementary and secondary school levels. As noted by Akerhielm (1995), however, most of these studies have found no significant relationship between class size and academic performance.¹⁰

Writing requirements

The effect of essay exams or paper assignments on student understanding is difficult to predict *a priori*. Instructors in introductory economics courses often find that students experience difficulty working with graphs. While a paper assignment may enhance student understanding of a particular topic, it is also likely to induce a substitution effect in which students substitute time studying other economic concepts for a more in-depth understanding of a particular topic or issue. Those who assign such papers often find that students devote most of their research effort to investigating the issue under analysis but do not generally devote a substantial effort to

⁹Indirect support for this argument may be found in McKeachie (1990) who argues that an examination of psychological studies suggests that the types of learning activities that take place in large class instruction may encourage short-term recall of factual knowledge for course exams. He argues, however, that the traditional lecture methods used in large class instruction will have a weaker impact on the development of higher-level cognitive skills and long-term recall than the essay exams, discussion methods, and other student-centered approaches that are only feasible in a small class environment. It should be noted, though, that none of the studies examined in McKeachie's survey article, however, examined the impact of class size or pedagogical techniques on student learning in economics classes.

¹⁰Akerhielm suggests that the reason for the insignificant results in most studies is the nonrandom sorting of students into classes at the elementary and secondary school levels. If, as her results indicate, more difficult or less able students are sorted into smaller classes, the observed relationship between class size and student performance will not fully capture the adverse effect of class size. This argument, however, is unlikely to apply to the sorting of students into small- and large-enrollment sections in a typical college environment.

developing the theoretical analysis appropriate to the topic. This may also divert student time away from the study of economic theory to the study of current events or a particular policy topic.

The learning incentives induced by essay exams are also difficult to predict *a priori*. On the one hand, free-response essay questions may induce risk-averse students to divert more efforts to studying economic theory. It is not uncommon, however, for students to be able to predict the basic topics that will be covered on essay exams. Some instructors simplify this process for students by providing students with sample essay exams or with study guides that provide clues concerning the topics that are likely to be covered on the exam. Since a narrower range of topics is likely to be covered even on carefully designed essay exams (due to time constraints in the typical test environment), students may direct more intensive study efforts to a narrower range of topics when faced with such exams. Since multiple-choice exams typically cover a wider range of topics, it is possible that students will study a more diverse mix of topics in preparing for such exams. Whether this tradeoff between depth and breadth of study effort enhances student's long-term understanding of basic economic concepts is something that can only be determined empirically.

Patrick B. O'Neill (1998), comparing the effect of essay and multiple choice exams in introductory macroeconomics classes, found that student performance on the macroeconomics TUCE exam is higher at the end of the class when multiple choice exams are administered during the semester. O'Neill also finds that the type of test administered during the semester has no significant impact on either student attitude towards the course or average exam score in the course. One interpretation of these results is that students who have had more recent experience

with multiple choice economics exams will perform better on a multiple choice measure of achievement such as the TUCE. An alternative explanation is that student exam grades are curved by the instructor so that similar distributions of final grades appear even though different levels of understanding may result under these alternative student assessment measures.

In the discussion that follows, we measure student recall of economic concepts one or more semesters after the completion of the microeconomics principles course. We believe that any differential effect in understanding that occurs at that point is more likely to be the result of differences in student understanding rather than differences in recent experiences with multiple choice exam formats.

Depreciation and replacement investment

Since it is likely that the stock of economic knowledge will decline over time, it is anticipated that, *ceteris paribus*, student performance on the microeconomics TUCE will decline the longer the time interval since the completion of their introductory economics course. The completion of additional economics courses, however, will be expected to maintain and enhance the stock of economic knowledge acquired in the introductory microeconomics course.

Other variables

In addition to the variables described above, a set of demographic and ability variables is also included in the regression model. The demographic variables include gender, race, and age (as measured by a dummy variable representing "nontraditional students"). Student ability, interest in the subject matter, and motivation is taken into account by including the student's

grade in the microeconomics principles course and a dummy variable for economics majors as regressors.¹¹ The grade in the principles course also serves as a proxy for the stock of economic knowledge acquired by the student by the end of the course. It is anticipated that students who have acquired more knowledge, as measured by course grade, will achieve higher TUCE scores.

Most previous studies suggest that females perform less well on the TUCE exam than do males.¹² Dynan and Rouse (1997, p. 361) indicate that gender differences in math ability (as measured by math SAT scores) account for most of the observed differences in test performance. Several studies have found that gender differentials in performance in economics classes do not appear to be related to the gender of the instructor.¹³ Lage and Treglia (1996), however, find that the inclusion of scholarship on women may reduce the gender differential in performance.

The effects of race on student performance on the TUCE exam has not been as extensively investigated as the effect of gender. It is likely that the race variables will serve as a proxy for differences in family income, parents' education, school quality, and other socioeconomic factors.

¹¹The category of "economics major" used in this study includes all students with declared first or second majors in either a B.A. degree program in economics or a B.S. degree program in applied mathematical economics.

¹²See for example: Agarwal and Day (1998), Dynan and Rouse (1997), Anderson, Benjamin, and Fuss (1994), Myatt and Waddell (1990), Heath (1989), Lumsden and Scott (1987), and Crowley and Wilton (1974).

¹³See, for example, Sheets, Topping, and Hoftyzer (1995); Dynan and Rouse (1997); and Robb and Robb (1999). Ferber (1995) argues that the lower level of performance of female students is partly the result of a male bias in the selection of the content of introductory textbooks as well as in mainstream economic methodology and analysis.

II. Data

The TUCE exam and survey instrument were administered to 385 students who were students in upper-level economics classes at SUNY-Oswego at the start of the spring 1999 semester. In each class, the TUCE exam and survey instrument were administered during either the first or second class meeting prior to the discussion of any economic content.¹⁴ After excluding those cases in which respondents did not provide information on one or more of the variables used in the analysis that follows, the sample consisted of 295 observations.

Table I contains definitions of the variables used in this analysis. Descriptive statistics for these variables appear in Table II. One disconcerting result was the relatively low mean TUCE score. A mean TUCE score of 10.4 corresponds to approximately a 21st percentile¹⁵ as compared to students who completed the TUCE exam at the end of their microeconomics course in the original TUCE III norming sample.¹⁶ While this relatively low score may suggest that students beginning upper-level courses at this institution have a relatively low level of recall of fundamental economic concepts, it is likely that the low percentile score is indicative of a lower level of student ability at this institution as compared to the sample used to norm the TUCE III exam.¹⁷

¹⁴Some instructors chose to discuss the syllabus during the initial class meeting since the administration of the TUCE and survey instrument required the entire scheduled meeting time for classes meeting three times per week.

¹⁵Linear interpolation was used to approximate the percentile score at the sample mean.

¹⁶It is somewhat troubling to note that this score approximately corresponds to a 51st percentile for students who were just beginning an introductory microeconomics course in the original TUCE III norming sample.

¹⁷In a separate study, the economics department at this institution administered the microeconomics TUCE III exam to all students in introductory microeconomics courses at the

Since the SUNY-Oswego economics department plays a large service role in providing upper-level courses required in a variety of business school programs,¹⁸ it is not surprising to see that only 9.2% of the students in these courses were economics majors. The relatively low proportion of females in these classes is consistent with the gender mix found in economics courses in several other studies. Because of the college's geographical location, a relatively small proportion of the student body is nonwhite. Nearly 10% of the sample consists of nontraditional students who were 24 years old or older.

The mean time since the completion of the introductory microeconomics course is nearly 5 semesters. Since the mean number of economics courses is nearly 3, a substantial portion of the sample has completed one upper-level economics course in addition to the two introductory courses.

The mean grade for students in introductory economics courses (2.862) is substantially above the 2.0-2.3 mean grade received by students in introductory microeconomics classes at this institution. This may be due to the relatively large proportion of transfer students,¹⁹ the likelihood that some students who receive low grades during their first two years fail out of the

start of the Spring 1999 semester. The mean TUCE score for these introductory microeconomics students is 8.19, corresponding to approximately a 27th percentile relative to the original TUCE norming sample. Since the quality of students at this institution has been relatively stable over the past few years, it is likely that the current cohort of upper-division students would have received similarly low pre-test TUCE scores. Thus, it does appear that students have retained some knowledge from their introductory microeconomics course.

¹⁸Each major program in the business school requires at least one upper-division economics course, and most business majors require students to complete two upper-division economics courses.

¹⁹As shown in Table 2, 21.7% of the students in upper-level courses completed their introductory microeconomics class at a 2-year college and 7.1% of these students completed the course at a different 4-year college.

institution, and that those who performed relatively well in the principles course are more likely to become a major or minor in economics (and thereby be disproportionately represented in the sample of upper-division economics students). 32.5% of the students in the sample reported that they had been participants in large-section introductory microeconomics classes; 23.7% of the sample had enrolled in introductory microeconomics classes that used essay exams or paper assignments.

Table 1: Variable Descriptions

Name	Definition
TUCE	= raw score on microeconomics TUCE III exam
Econ	= 1 if the respondent is an economics or applied mathematical economics major (= 0 otherwise)
Female	= 1 if the respondent is female (= 0 otherwise)
Black	= 1 if the respondent is black (= 0 otherwise)
Hispanic	= 1 if the respondent is Hispanic (= 0 otherwise)
Asian	= 1 if the individual is Asian (= 0 otherwise)
Nontrad	= 1 if the respondent's age is greater than or equal to 24 (=0 otherwise)
NSEM	= number of semesters since the completion of the microeconomics principles class ²⁰
NECON	= total number of economics courses completed prior to the current semester
Grade	= numeric value of letter grade received in the class on a 4 point scale (+/- grading is used)
2yrCol	= 1 if the individual completed this course in a 2-year college (= 0 otherwise)
4yrCol	= 1 if the individual completed this course at another 4-year college or university (=0 otherwise)
Large	= 1 if the respondent reported that 75 or more students were enrolled in the introductory microeconomics course (= 0 otherwise)
Writing	= 1 if the respondent reported that essay exams or paper assignments were used in the introductory microeconomics course (= 0 otherwise)

²⁰The most recent semester reported is used to compute this variable when respondents report multiple attempts at completing this course.

Table 2: Descriptive Statistics

Variable	Mean	Standard Deviation
TUCE	10.400	3.884
Econ	0.092	0.289
Female	0.430	0.496
Black	0.024	0.152
Hispanic	0.020	0.141
Asian	0.041	0.198
Nontrad	0.098	0.298
NSEM	4.919	3.958
NECON	2.983	1.356
Grade	2.862	0.762
2yrCol	0.217	0.413
4yrCol	0.071	0.258
Large	0.325	0.469
Writing	0.237	0.426

Number of observations = 295

III. Empirical Results

Table 3 contains the results of the regression analysis. Most of the results are consistent with expectations. As anticipated, economics and applied mathematical economics majors score significantly higher on the TUCE exam, even though the number of previous economics courses, microeconomics principles course grade, and other factors are held constant. This is probably the result of a sorting process in which those who have the greatest interest in and penchant for

economic analysis choose to become economics majors.

As found in other studies, gender has a significant effect on TUCE scores. While black students, on average, receive TUCE scores that are over two points lower than white students, this result is only weakly significant. No significant effects are found for the other racial dummy variables. Given the relatively small population of nonwhite individuals in this sample, though, these results should be treated with some skepticism. The estimated coefficient and *t*-ratio for the nontraditional students variable at least weakly suggest that nontraditional students outperform younger students in terms of their ability to recall fundamental economic concepts from their introductory microeconomics courses.

As anticipated, the ability to recall economics concepts declines with the number of semesters. It was somewhat surprising, though, to see that the number of prior economics courses had no significant effect on the ability to recall fundamental microeconomic concepts. This may be due to the fact that, for business majors, the most popular upper-division elective is Money and Banking, a course that focuses somewhat more on macroeconomic concepts. Since a large proportion of the sample consists of business majors who have completed only one upper-division economics course, the insignificant effect of the NECON variable may be due to the limited coverage of microeconomic theory and analysis in the Money and Banking course..

It is reassuring, though, to see that the grade in the introductory principles course is very important in explaining how much a student will recall. This suggests that the assessment instruments used to evaluate student performance in introductory classes are good predictors of how much of this material students are able to recall in the future. There is no significant difference between the performance of students who completed the introductory microeconomics course at SUNY-Oswego

and those who completed the introductory course in other colleges.

Table 3: Regression Results

Variable	Coefficient	t-ratio	p-value²¹
Constant	4.821	5.389	< 0.00001
Econ	2.543	3.028	0.00269
Female	-0.833	-2.147	0.03267
Black	-2.263	-1.830	0.06836
Hispanic	-0.665	-0.496	0.62038
Asian	0.467	0.490	0.62450
Nontrad	1.197	1.734	0.08409
NSEM	-0.103	-1.952	0.05194
NECON	0.175	0.981	0.32746
Grade	2.046	7.735	< 0.00001
2yrCol	-0.672	-1.293	0.19693
4yrCol	0.621	0.811	0.41805
Large	0.759	1.712	0.08792
Writing	-1.611	-3.324	0.00100

$R^2 = 0.355$

adjusted $R^2 = 0.325$

$F(13,281) = 11.91$ (p-value is less than 0.00001)

The most interesting results, though, are the estimated coefficients and *t*-ratios for the class size and writing variables. These estimates provide reasonably strong evidence that enrollment in large-section introductory microeconomics classes does not adversely affect the amount of basic

²¹The p-value reported in this column is the exact significance level for a two-tailed test.

microeconomic knowledge that students possess at the start of their upper-level economics courses. These results can also be interpreted as providing at least weak evidence that large-section instruction may actually increase the amount of knowledge that students recall.

The highly significant and negative coefficient on the writing variable suggests that the use of multiple choice exams as the primary assessment tool increases the amount of microeconomics concepts that students remember at the start of their upper-level courses.

IV. Conclusions

The results presented above suggest that the use of writing assignments and essay exams in introductory microeconomics classes may result in a weaker long-term understanding of fundamental economic concepts, as measured by the TUCE III exam.²² While writing assignments of this sort may improve student writing skills, it also appears that they have a significant opportunity cost in terms of student understanding of economic theory. This cost should be taken into account in determining whether such requirements should be adopted.

At the very least, it appears that large-class instruction does not harm student performance, and may actually enhance it. This is encouraging information for those departments that routinely offer such courses.

²²It would be interesting to examine whether such a relationship would also be found if a free-response essay test was used in place of the TUCE as a measure of performance. Such a study is under consideration for implementation during the Fall 1999 semester at this institution.

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